DSN Data Record Generation

E. C. Gatz

DSN Systems Engineering Office

The DSN is implementing a central log (GCF Log) of all data received and/or generated in the Deep Space Network. Selected data from the log are sorted and placed in time order to form an Intermediate Data Record (IDR). This IDR is the principal nonreal-time interface with flight projects.

I. Introduction

The generation and handling of data records for deep space missions has always been included as one of the DSN tasks. Each Flight Project has also provided processing, storage, and distribution of data records as part of its mission. In the past, each project has handled the total data record process in different ways to satisfy the particular needs of the various data users. This article describes a standard data record system being implemented by the DSN, and shows how this system fits into the total data record process.

II. Requirements

The principal requirement for the data record process is to deliver adequate quantities of data in the form of a Master Data Record (MDR) or at least to deliver the data for production of the MDR. There have been numerous attempts to quantify this requirement, but without much satisfaction. Therefore the requirements evolve to the following:

(1) Content: all data received or generated above threshold.

(2) Time: MDR production nearly in real-time (approximately 24 hours).

(3) Operations: process shall have simple interfaces and simple operation.

III. General Configuration

The data record process configuration is shown in Fig. 1. This diagram indicates the functions performed by the DSN, and also those to be handled by Flight Projects, and by the Mission Control and Computing Center (MCCC). Contents and formats of the various data records are defined in Section V.

A. DSN Functions

The DSN functions indicated in Fig. 1 are as follow:

(1) Make the Original Data Records (ODRs) at each Deep Space Station (DSS).

(2) Make a central log (GCF Log) of all data.

(3) Monitor operation, and effect replays from the ODR.

(4) Sort and merge the GCF Log to generate the Intermediate Data Records (IDRs).

B. MCCC Functions

The MCCC functions indicated in Fig. 1 include:

(1) Generate the System Data Records (SDRs) for quick-look and real-time operation.

(2) Generate the Master Data Records (MDRs) from the IDRs.

C. Project Functions

Finally, project functions include:

(1) All quick-look processing that is used for mission operations.

(2) Experiment Data Record (EDR) processing. This is interpreted to include all processing required to select and format mission data for use by the scientific community. Historically, much of the radio metric data processing falls in this category since that processing is done as part of the orbit determination.

IV. DSN Implementation

The significant implementation to be accomplished by the DSN is the central GCF Log and the processing to generate the IDRs. This implementation is included in the Network Control System (NCS), which has been described in Ref. 1. The configuration for these functions is shown in Fig. 2.

The GCF Log is recorded by the communications log processor. Two processors will be implemented, one as a hot standby. All real-time data will be routed to real-time monitors that will generate System Performance Records and data gap summaries. These items are regularly transferred to the Network Support Controller for compilation

into pass summaries. At regular intervals, usually at the end of a pass, the recall lists are generated. These lists are used to recall from the ODR any data missed in real-time.

The playback of ODR recalls is automatically controlled. The processor to accomplish this is the backup NCS display processor. This is also being implemented to perform the off-line conversion of the GCF Logs to IDRs. This conversion consists of the selection of data from the GCF Log, and time ordering of all real-time and recalled data. The selection is on the basis of data type, DSS, spacecraft number, and time interval.

This capability is now planned as part of the Block III NCS (defined in Ref. 1), scheduled to be operational on February 1, 1976. It is planned that the IDR will be generally available within 24 hours after the data have been received at a DSS. The IDRs will cover selected time intervals up to 100% of the data on the ODR, and will be available to projects as requested or negotiated.

V. Data Record Definitions

A. Original Data Record (ODR)

ODRs are those records made by digital recorder at the Deep Space Station at the time of data receipt or generation. The station places time tags on the record that are correlated to the data. ODRs are made for radio metric, telemetry, command, and monitor data. Appended to the data are certain ground system performance measurements, such as receiver automatic gain control (AGC), signal-to-noise ratio, and doppler mode. The records are in high-speed data block format, ordered in Earth-received time (ERT). Multiple recorders at a DSS lead to different tapes, some tapes with multiple data streams mixed together.

B. GCF Log

The GCF Log is that record made at the GCF central communications terminal at JPL of all inbound and outbound GCF blocks in the order of receipt. This record contains data received in real-time, and also data replayed from Deep Space Station records. This record, formatted in GCF data blocks, is on magnetic tape, with data in the order received. Multiple data types are mixed together, and recall data may be at the end of a pass or mixed in with the other data from that pass. A single tape may have data from more than one spacecraft, and more than one pass.

C. System Performance Record (SPR)

SPRs are digital magnetic tape records of a time history of DSN performance as generated by the network control tracking, telemetry, and command subsystems and compiled in the NCS. These records are organized according to DSN System, spacecraft and station. They identify all missing or defective data and system status. The SPR compiled by the network control monitor and control subsystem contains a time history of overall DSN performance and is called the Network Performance Record (NPR).

D. Intermediate Data Record (IDR)

This digital record (made from the GCF Log) contains all the GCF blocks, time ordered by Earth-received time, of a given data type, spacecraft, and Deep Space Station pass. This record contains, as minimum, the same data that is contained on the ODRs. This record is on magnetic tape and is an official interface to the Mission Control and Computing Center and remotely located projects for data records. The tape is in the same format as the digital ODR.

E. System Data Record (SDR)

The SDR is that digital data record generated separately at the MCCC by spacecraft and by system (tracking, telemetry, and command). The data in each record consist of data received in real-time as well as data received from nonreal-time sources. It may contain time gaps, duplicate information and extraneous data. Where applicable, ground system performance measurements, such as receiver AGC, signal-to-noise ratio (SNR), equipment configuration and lock status, and doppler mode, are included in SDR records. The SDR is ordered by time of receipt of the data at the MCCC.

This record is a standardized format for all flight projects and provides the MCCC interface with each flight project for project processing. The permanent form of this record is magnetic tape.

F. Master Data Record (MDR)

MDRs are digital data records obtained through specialized processing of data on the IDR, or equivalent. These consist of real-time data with data gaps filled in to achieve a required level of completeness. The data are organized in time-ordered sequence with respect to ground received time and usually tagged with spacecraft event time. Duplicate and extraneous data resulting from station overlaps are removed. An MDR may contain data for more than one system. Telemetry data are organized into frames rather than high-speed or wideband data blocks.

G. Experiment Data Record (EDR)

These digital data records are extracted from the MDR to provide the Principal Investigator (PI) with data associated with his experiment. The EDR is in instrument cycles and is ordered by spacecraft event time (the time at which the measurement is taken). The permanent form of the EDR is magnetic tape. This record is made by the flight project.

Reference

1. Edwards, J. N., "Network Control System Development," in *The Deep Space Network Progress Report*, Technical Report 32-1526, Vol. XVII, pp. 113-119. Jet Propulsion Laboratory, Pasadena, Calif., Oct. 15, 1973.
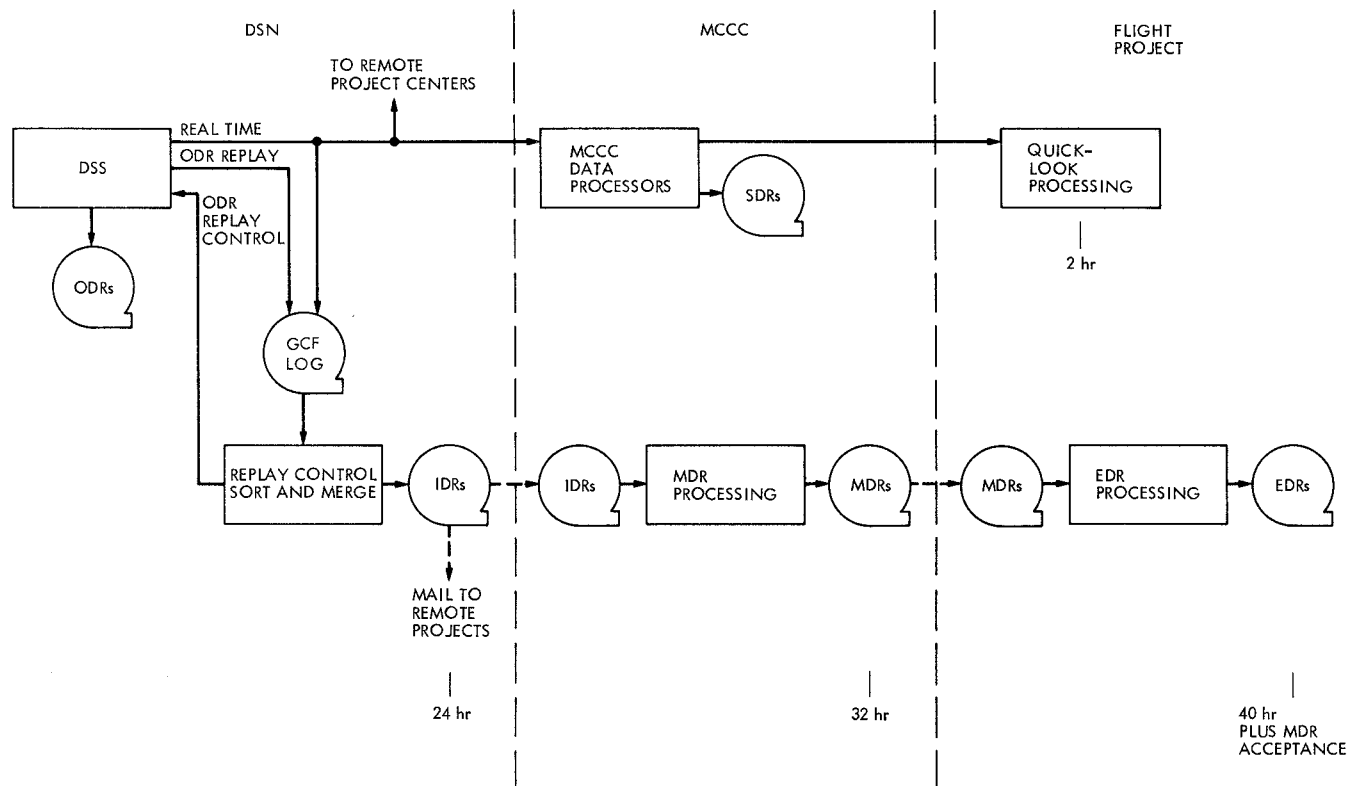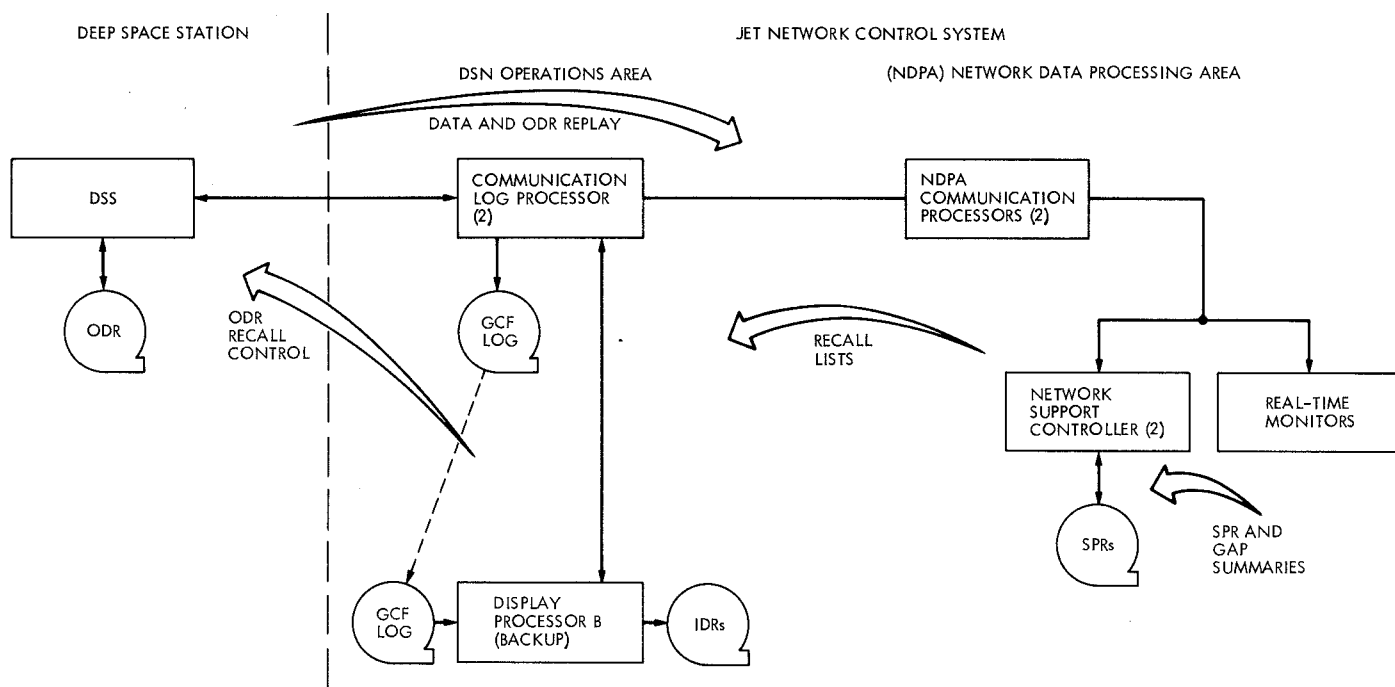
Fig. 1. Data record process — general configuration

Fig. 2. DSN data record generation